**Comments on CRITFC's January 26, 2011 letter to Oregon Environmental Quality Commission, including attachment by McCullough and Heinith**

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**February 8, 2011**

Comments on the letter are restricted to the technical issues related to the IPC request (not on the broader issues that are beyond the scope of the site-specific thermal criterion). Comments on the attachment follow page and paragraph, with identification of CRITFC's quotes as identified by the Petition's page numbers. References I use are included with each comment.

## LETTER

The CRITFC letter recommending denial of the site-specific criterion highlights a perceived complexity of technical analysis, which is a misperception. The letter states: "The proposal to establish site-specific criteria for temperature in the Hells Canyon Reach requires a great deal of complex, technical analysis." (top of page 3). Also: "The complex nature of this rule is without question. There still remains a great deal of scientific uncertainty…"

The perceived complexity and scientific uncertainty is a product of the appended technical analysis, which inadequately (and sometimes erroneously) evaluates the relevant scientific studies, argues for use of a body of unreferenced studies with low relevance to the issue, and introduces a multitude of far-reaching considerations that are not relevant for the IPC request. Much of the appended material addresses a scope far beyond the issue for the present proceeding, both spatially (across the Snake River basin) and temporally (especially summers preceding the dates of the IPC Petition. A large part of the appendix is focused on opposition to Oregon's existing 20°C summer temperature standard for the Snake River instead of the temperatures and dates of the IPC request.

The technical issue is, in fact, quite straightforward. In a declining temperature typical of spawning and incubation of fall Chinook salmon in the Columbia River basin, the factor that most influences survival of embryos is the temperature of initial incubation. There is experimental evidence of this from several years of studies of fall Chinook incubated in declining fall temperatures at the Hanford site in the 1950s and 1960s by P. A. Olson and colleagues. They determined that the threshold for an effect occurs near an initial incubation temperature of 16°C. These early results were corroborated by a series of highly detailed experimental studies at carefully controlled temperatures by D. R. Geist and colleagues using the fish stock of interest from the Snake River and temperature declines typical of the Snake below Hells Canyon Dam. The threshold for effect near 16°C is now known for this race of Chinook salmon with high scientific certainty. IPC includes a margin of safety of 1.5°C below the threshold in its request for a site-specific criterion of 14.5°C.

## APPENDIX BY DALE MCCULLOUGH AND BOB HEINITH

### Egg Incubation

**Page 1, beginning of section (including quotations from p. 21/263):** CRITFC apparently believes that the "vast body of literature on thermal effects on salmonids in general" is more relevant to the present issue than the scientific data IPC provided that pertain to the actual fish stocks and actual site-specific thermal conditions. This is contrary to scientific experience, especially when none of the vast body of literature is specifically cited by CRITFC in support of their claim. The purpose of a site-specific criterion or standard is to focus on the specific conditions and circumstances of the actual locality and the resources affected there.

**Page 1, second paragraph:** CRITFC criticizes IPC for relying on the work of Olson and colleagues on effects of chronic water temperatures on survival and growth of young salmon. CRITFC asserts that Olson used only one adult pair of spawners for the eggs to be tested and thus the results "should be rejected on these grounds." Their comment, however, provides an incomplete and inaccurate summary of the work by Olson and colleagues referenced by IPC. A 1955 paper by "Olson et al." is cited by CRITFC with no reference citation. Actually, this was an early exploratory paper by Olson and Foster (1955). The more-substantive research was published in annual reports by Olson and Nakatani in 1968 (four pairs of parents) and 1969 (five parental pairs) and in a summary laboratory report by Olson, Nakatani and Meekin (1970), which is cited later in their comments. CRITFC's critique of the Olson studies cited by IPC is thus untenable.


Olson, P. A., and R. F. Foster. 1955. Temperature tolerance of eggs and young of Columbia River Chinook salmon. Trans. Am. Fish. Soc. 85:203-207.

Olson, P. A., and R. E. Nakatani. 1968. Effect of elevated temperatures on mortality and growth of young Chinook salmon. Pages 9.3-9.5 in Pacific Northwest Laboratory Annual Report for 1968 to USAEC Division of Biology and Medicine, Volume 1, Part 2. BNWL-714. Battelle-Northwest, Richland, Washington.

Olson, P. A., and R. E. Nakatani. 1969. Effects of chronic variable temperatures on survival and growth of young Chinook salmon. Pages 2.35-2.38 in Pacific Northwest Laboratory Annual Report for 1968 to USAEC Division of Biology and Medicine, Volume 1, Part 2. BNWL-1050. Battelle-Northwest, Richland, Washington.

Olson, P. A., R. E. Nakatani, and T. Meekin. 1970. Effects of thermal increments on eggs and young of Columbia River fall Chinook salmon. BNWL-1538. Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington.


**Page 1, bottom paragraph:** CRITFC criticizes IPC's reliance on the survival study by Geist et al. (2006) because it held the adults initially at 12°C before testing embryos at initial temperatures of 13-17°C. CRITFC considered 12°C a "benign treatment [that]

eliminates much of the potential impact of temperature on pre-spawning adults…gametes and earliest stages of egg development....” CRITFC does not acknowledge, however, that the Snake River 94 km downstream of the Hells Canyon Reach, through which adults must migrate, is cooler than immediately below Hells Canyon Dam (Connor et al. 2002). The 12°C holding temperature may be a reasonable simulation of the cool-temperature exposures encountered by many adult migrants near the median time of spawning. Early spawners will experience somewhat higher temperatures. With cool thermal refuges available and the migration and holding routes of adults difficult to know, replicating the adult exposure temperatures for a controlled lab study would have been very difficult. It was preferable to have pre-spawning fish held similarly in a known environment, which was provided by the Lyons Ferry hatchery. CRITFC provides no evidence of significant differences in temperature effects on pre-spawning adults, gametes, and early stages of development between 12 and 14.5°C (the limit proposed by IPC). CRITFC’s criticism appears to be more directed toward adequacy of the existing 20°C standard for the migration period, which is presumably protective of the adults and gametes.

Connor, W. P., H. L. Burge, R. Waitt, and T. C. Bjornn. 2002. Juvenile life history of wild fall Chinook salmon in the Snake and Clearwater rivers. N. Am. J. Fish. Wildl. Manag. 22:703-712.

Geist, D. R., C. S. Abernathy, K. D. Hand, V. I. Cullinan, J. A. Chandler, and P. A. Groves. 2006. Survival, development, and growth of fall Chinook salmon embryos, alevins, and fry exosed to variable thermal and dissolved oxygen regimes. Trans. Am. Fish. Soc. 135:162-1477.

**Page 2, first paragraph:** CRITFC also criticizes the work of Geist et al. (2006) for using well water for egg incubation. They apparently do not realize that the well water is obtained from hyporheic (inter-gravel) flow in unconsolidated gravels adjacent to the Columbia River. CRITFC provides no evidence that such well water would differ significantly from hyporheic water that flows in salmon redds in the river gravel.

**Page 2, second paragraph (including quote from p. 256/263).** This is an accurate, general statement based on Olson et al. (1970), which I cited, although no specific temperature for the sensitivity is given. It does not contradict IPC’s statements or the work of Geist et al. (2006). CRITFC’s purpose in citing the statement is not clear, except perhaps to assert their favor for generalizations instead of detailed information.

**Page 2, bottom two paragraphs:** CRITFC’s critiques here are convoluted and difficult to follow. Despite CRITFC’s assertions, the IPC logic is clear. As CRITFC acknowledges, spawning history indicates that a small percentage of the run spawns prior to November 1 (Rondorf and Tiffan 1997; reference not provided by CRITFC) and is little affected by water temperature. IPC noted that no more than 2% of the spawning distribution occurs >16°C between October 10 and 18. That there is a “significant relationship between spawning and water temperature” while both variables are changing over time does not signify causation. The relevance of CRITFC’s reference to the Clearwater spawning, where temperatures are much colder through the summer and fall

than below Hells Canyon, is not clear. Reference to Connor et al. (2003a) does not seem to support CRITFC's critique, because slightly warmer temperatures below Hells Canyon would tend to do just what CRITFC suggests is desirable: earlier spring emergence and outmigration when river flows are high and temperatures low.

**Spawn Timing**

**Page 3, top two paragraphs:** The argument presented by CRITFC in the two top paragraphs is contrary to current understanding of Snake River temperatures and salmon survival and development times. First, they are correct that IPC assumes that temperatures as high as 14.5°C cause no harm. This is based on detailed studies using regional fish stocks and a range of incubation temperatures (Olson studies and Geist studies). IPC is being precautionary, however, when it does not assume lack of harm to 16.5°C (even though some of the research data would support that temperature threshold). IPC selected 14.5°C as a temperature sufficiently below the threshold temperature indicated by the detailed research as to provide a margin of safety.

Second, the spawning and development scenario presented by CRITFC, in which a benefit would accrue to only the approximately 2% of fish spawning in temperatures above 13°C, is inconsistent with Snake River temperatures through the fall spawning period. The benefit accrues to subsequent spawning, as well. As presented in the Petition (Petition Figure 2) water temperatures that are initially higher in the fall persist as slightly warmer temperatures (below the criterion of 13°C) for several weeks. Compared to eggs spawned at 13°C and below (as seasonal temperatures decline), eggs spawned at warmer initial temperatures and incubated at slightly elevated temperatures during the temperature decline will develop faster (as shown in the laboratory studies by Olson, Geist and colleagues). The continuation of slightly warmer temperatures in the river as the water temperature declines seasonally (compared to starting at 13°C) means that embryo development is advanced by the time development is slowed by cold winter water temperatures. The more advanced young in the redds would logically emerge somewhat earlier in spring than those initially incubated at colder temperatures and thus show an earlier outmigration. Although specific scientific studies have not followed development of embryos and alevins in the redds in the river, this scenario of overall advancement of development due to slightly warmer initial temperatures is consistent with the laboratory tests and field observations of outmigration by Connor and colleagues.

**Page 3, third paragraph and page 4, top paragraph (including quotation from p. 32/263).** CRITFC's presentation of details from Zimmer (1950) would appear to substantiate that spawning occurred even earlier than early October when temperatures were likely warmer. The quotation from Zimmer does not otherwise contradict the statement in Groves (2007).

**Gamete Viability**

**Page 4, second and third paragraphs (including quotations from p. 58/263 and p. 256/263).** CRITFC's criticism of IPC for discounting research studies on gamete survival at constant temperatures is overly severe considering that those studies (not cited by CRITFC, however) did not simulate the type of exposures that would be experienced by fall Chinook salmon in the Snake River. In lieu of manipulating those constant-temperature study results to develop predicted responses (as I suggested could be done when no effects data at declining temperatures are available; **p. 256/263**), IPC chose to rely on previous research that matched the type of actual temperature exposures (by Olson and colleagues) and to fund studies specifically designed to replicate likely in-river exposures (by Geist and colleagues). When given the option, it is generally accepted scientific practice to rely on the most relevant research rather than extrapolating from less relevant information, no matter how voluminous that less-relevant information may be. This can hardly be called "[r]igid adherence to a 'scientific' standard meant only to exclude the bulk of literature…"

**Page 4, bottom paragraph and page 5, top paragraph (including quotations on p. 245/263 and p. 98/263).** CRITFC appears to equate daily temperature fluctuations with seasonal differences. Minimal daily fluctuations (that is, fluctuations in temperature within a day) are not the same as the seasonal differences indicated by the second quotation.

**Page 5, second paragraph (including reference to quotation on p. 98/263):** CRITFC's purpose is not clear in its criticism of IPC for not using a test (presumably from the literature but not cited) that used a 40-day exposure of Chinook salmon embryos to constant elevated temperatures. IPC's petition is not for allowing temperatures above 19°C or for constant temperatures of 40 days duration. The statement on p. 98 simply states that some very early fish could experience temperatures well above the current standard of 13°C or the proposed site-specific standard of 14.5°C. These very early fish would be a small number considering that only about 2% of the run spawns as soon as early October.

**Page 5, third paragraph (including quotation from p. 254/263).** I disagree that a decining temperature of 0.2°C per day for 5 days is "essentially a constant temperature." It is, in fact, a 1°C total decline.

**Page 5, fourth paragraph:** CRITFC agrees that a test with a 30-day exposure to a constant elevated temperature does not equate to a 5-day exposure with declining temperatures of one degree, but nonetheless considers the 30-day test to be "useful as guidance." A constant temperature test with an exposure of 5 days might have been useful, but that was not what was done in the study CRITFC proposes to be used. As noted before, given the choice between relying on published data (as suggested by CRITFC) that are, at best, marginally relevant or, alternatively, data obtained from experiments that closely mimic the expected thermal regimes (as used by IPC), one would be on shaky scientific grounds to prefer the less relevant information. The fact that most thermal effects studies with "constant" temperatures have inaccurate temperature control does not equate to studies that mimic declining temperatures over time.

**Page 5, fifth paragraph:** The citation by CRITFC of a growth study by Imholt et al. (2010) on growth of juvenile Atlantic salmon is not relevant to the current Petition. IPC's request deals with a site-specific temperature standard at a time of declining temperatures, not a matter of fluctuating daily temperatures about an average temperature over a long exposure. The cited study does not justify use of long-exposure thermal-effects experiments at constant temperatures, even with some daily fluctuation, in lieu of data from experiments that mimic actual in-river exposures.

**Page 5, bottom paragraph and continuing to end of section on page 6:** The King et al. (2003, 2007) studies cited by CRITFC do not appear to be relevant to the issues considered in IPC's Petition for a limited-duration, site-specific temperature standard of 14.5°C below Hells Canyon Dam for a short period in the fall. Summer temperatures in the Snake River that may reach 22°C are not the issue here. The results cited by CRITFC contrast the poor performance of adults held for 6 weeks at 22°C with presumed acceptable performance for holding at 14 and 18°C. Although the King et al. studies were of Atlantic salmon, these data would not support the CRITFC claim that 14.5°C is detrimental for Chinook salmon. The acknowledged differences in thermal tolerances between Atlantic and Chinook salmon tend to negate the relevance of the King et al. studies to the Snake River situation.

**Pre-Spawning Mortality**

**Section beginning on page 6 to citation of p. 228/263 near bottom of page 7:** CRITFC's discussion of pre-spawning mortality in the Snake River is largely unrelated to the issues of IPC's Petition. A 1.5°C addition to the allowable temperature below Hells Canyon Dam for a one-week period in the fall will not impact temperatures that occur in the river in the preceding summer. Although CRITFC criticizes IPC for not having data on suspected thermal refuges and their use by pre-spawning salmon, and also criticizes IPC's analysis of fish-to-redd ratios as evidence for low pre-spawn mortality, CRITFC provides no evidence to invalidate IPC's quite logical inferences.

As a general comment on the pre-spawn mortality issue, it is difficult to reconcile CRITFC's concerns for adult pre-spawning mortality with the present high returns and spawning levels of the fall Chinook in the Snake River below Hells Canyon Dam. According to the joint interagency redd survey in fall and winter 2010, a record number of fall Chinook both passed Lower Granite Dam and spawned in the mainstem and tributaries (Nez Perce Tribe et al. 2011). A record high of 2,944 redds was observed in the mainstem Snake River in a 100-mile reach downstream of Hells Canyon Dam compared to a 2002-2010 average of 1,643. There also were record numbers of redds in tributaries to this reach. Use of tributaries, while not direct evidence of their use as thermal refuges early in the migration season as indicated in IPC's Petition and contested by CRITFC, indicates that such use is likely.

Nez Perce Tribe, US Fish and Wildlife Service, Idaho Power Company, Washington Department of Fish and Wildlife, and Pacific Northwest Laboratory. 2011. 2010 Snake River fall Chinook salmon spawning summary.

**Page 7, paragraph beginning at bottom of page:** CRITFC considers IPC's reliance on standard scientific principles for citing information, its use of information specific for fall Chinook salmon, and its use of only studies that tested declining temperature regimes to be a disregard for other scientifically valid reports. CRITFC cites IPC's use of Olson (1955) (actually Olson and Foster 1955) as an example of a non-peer-reviewed paper (because there was no reviewer acknowledgment). However, this paper was published in the *Transactions of the American Fisheries Society*, which has all its papers peer reviewed, whether the authors acknowledge them or not (generally, peer reviewers selected by journal editors remain anonymous anyway and would not be acknowledged by the authors). IPEC was careful to use peer-reviewed papers or studies with rigorous scientific methods to ensure an analysis of high scientific quality. That goal was met.

**Pages 8-9, from citation of p.243/263 on page 8 through the first paragraph of page 9:** CRITFC's detailed discussion of the data in Olson et al. (1970) and the intent of its quotations from the Petition document were difficult to follow. Regardless of any shortcomings in the Olson et al. (1970) report or disagreements between CRITFC and IPC over it, IPC went the next step to obtain a more thorough, replicated study by Geist and colleagues (Geist et al. 2006). Even though the Olson and Geist studies generally agreed on a threshold for detrimental effects near 16°C initial incubation temperature, IPC conservatively selected 14.5°C as its proposed site-specific standard.

**Page 9, second paragraph, through the second paragraph of page 11:** As I noted above, CRITFC's discussion of pre-spawning mortality in the Snake River is largely unrelated to the issues of IPC's Petition. Prespawning mortality relates to the river temperatures downstream of Hells Canyon Dam in the summer and very early fall preceding spawning in the reach below the dam. Although high temperatures in the Snake River as a whole in summer are a problem, it is not a problem that is affected by the difference between 13°C and 14.5°C in the river below the dam in October. Resolution of the summer temperature issue should be approached in a different forum.

**Thermal Shift**

**Page 11, First paragraph, first line of section:** What is Appendix XX?

**Page 11, Second paragraph of section:** The Oregon temperature standards do not prescribe exactly what the whole natural temperature pattern should be, so it is impossible to quantify any divergence except in the October weeks specified in the standards (see next comment). It is generally understood that a "natural pattern" means that there should be a summer maximum and a winter minimum, with rising and falling temperatures between. This contrasts with situations where hyolimnetic water released from storage reservoirs in summer causes a thermal reversal of the normal pattern, such that there is cold water in summer and warmer water in winter. The Snake River does not

nearly approach that detrimental condition. There is no specified minimum, maximum, or rate of change in the Oregon standards. Nor is there a specified date when the highest or lowest temperatures must occur. There is also no definition of what the temperature pattern of the Snake River was historically that might define a "natural" pattern other than the prescribed change from 20°C to 13°C at a specific date in October.

**Page 11, third paragraph of section:** It would appear that CRITFC's objection is with the Oregon temperature standards as they now exist. It is my understanding that the standards for the river below Hells Canyon Dam set 20°C as the upper limit until October 23 followed by a weekly average of 13°C after October 23. Although I was not involved in setting these limits, I suspect that they were arrived at specifically to "mimic the natural pattern" of temperature decline during this period. A change in the allowed temperature for one week (October 23-29) to 14.5°C from 13°C will not negate a natural pattern of temperature decline at this time. It actually could smooth an otherwise abrupt drop in the temperature standard and provide temperatures that would conform more to the normal rate of change.

**Page 12, top paragraph:** IPC appears to have done what CRITFC recommends, that is use temperatures in the week prior to first spawning as a "forward weighting" to the temperatures. Oregon's standard, on the other hand, uses average temperatures for the week after first spawning. Unless the meaning of "forward weighting" is misunderstood, this would seem to be conservative (precautionary), as CRITFC wishes. Again, CRITFC's criticism seems to be with Oregon's existing temperature standards.

**Page 12, second and third paragraphs (including quote from p.63/263):** CRITFC's critique of the upper-basin-wide TMDL process is far beyond the scope of the IPC Petition. After passage of water through two large reservoirs with lake-like thermal dynamics, the temperatures of the upper basin would not be directly reflected in temperatures below Hells Canyon Dam, although some influence likely could be shown at time of fall Chinook spawning. CRITFC provides no evidence or analysis that indicates the cumulative impacts of all the upstream hydropower projects would negate the IPC-proposed 14.5°C limit for one week in October.

**Adult Migration**

**First paragraph of section (including quote from p. 32/263):** Again, the issue of long-term historical trends in Snake River temperature go far beyond the matter of IPC's Petition. Regrettably, there appear to be few records of water temperature prior to development of the HCC. There seem to be only two ways to reconstruct those temperatures, one being use of what data do exist (Central Ferry). The other is to do a reconstruction of likely water temperatures with a simulation model that is based on known physical principles of heat transfer and relationships between water temperature and known air-temperature records, such as at nearby airports. As the CRITFC quote from p. 63/263 indicates, IPC has done both. IPC's claim for lower maximum temperatures after HCC (p. 32/263 quote) is supported by well-known information on

influences of reservoir systems on annual temperature cycles of their rivers, including the Columbia River (e.g., Jaske and Synoground 1970).

> Jaske, R. T., and M. O. Synoground. 1970. Effect of Hanford Plant operations on the temperature of the Columbia River 1964 to the present. BNWL-1345. Battelle-Northwest, Richland, Washington.

**Page 13, 2nd through 4th full paragraphs:** The issue of climate change and potentially warmer waters in the basin as a whole, while of general concern, is far beyond the present Petition. Regardless of any climate change, the issue is one of changing a site-specific standard from a weekly average of 13°C to an average of 14.5°C for one week in October. Both the existing standard and the proposed one would presumably remain in effect regardless of long-tem trends in basin-wide temperatures.

CRITFC's preference for "cold water releases" from Hells Canyon Dam to cool the lower Snake River for adult salmon migration seems in direct conflict with its own insistence that the natural temperature pattern be mimicked (page 11). Experience at other dams with cold-water releases in summer has prompted the inclusion of protections for a natural pattern in many state water temperature standards, including Oregon's.

**Disease Susceptibility**

**Page 13 to top of page 15:** In this section, again, CRITFC is arguing against the existing thermal standard of 20°C for the summer months (including its enforcement) instead of focusing on the issue of the Petition, which is a one-week change in the October cool-down period. The temperatures in the August-September-early October migration and holding period would not be changed by acceptance of the proposed site-specific standard. The same existing 20°C standard would apply before that week, and the same existing 13°C standard would apply after it. The proposed 14.5°C would bridge the unnaturally abrupt shift between them. The extensive comments and literature citations by CRITFC on adult vulnerability to disease at temperatures above 20°C are simply not relevant to the Petition proceeding, no matter how germane to salmon biology in general. As noted above, the record high numbers of both adult Chinook salmon and their redds in this region of the Snake River basin in 2010 suggest that the debate over disease susceptibility in the Snake River under current conditions may be more academic (hypothetical) than real.

**Bioenergetic Exhaustion**

**Entire section, pages 15-16:** While the issue of energy depletion by migrating Chinook salmon at elevated temperatures is clearly an issue for temperatures in the Columbia-Snake migration corridor in the August to early October period (and the existing standard of 20°C and its enforcement), it is not relevant to the issue of the Petition. The passages quoted discuss the issue in general terms, and not in terms of the Snake River below Hells Canyon Dam in mid to late October. CRITFC provides no evidence that a weekly average temperature of 14.5°C on one week in October (instead of 13°C) will have any

effect on energy reserves of salmon migrating up the Columbia-Snake corridor on earlier dates. Again, CRITFC's position relates to the existing standards for the migration corridor in summer and early fall, not to IPC's Petition. That issue requires a different forum.

**Synergistic Effects**

**Entire short section, page 16:** CRITFC's statement is certainly correct as a general principle, but it is not relevant to the subject of the Petition. It is more appropriately directed at the adequacy of the existing standard for the migration corridor.

**Swim Speed**

**Entire short section, page 16:** CRITFC explicitly criticizes temperatures "above 20 degrees C", which not an issue in the current proceeding.

**Other Water Quality Considerations**

**Entire short section, page 17:** It is not clear what temperature increase is referred to in this case. What two temperatures are compared? CRITFC presents no information from itself or EPA to substantiate that there is any violation.

**Impact of the HCC on the Snake River**

**Entire section, page 17:** It is difficult to follow CRITFC's reasoning when its evidence is presented in a table without column headings from an unknown source. The topic of temporal shift in water temperatures was already covered, and is a common phenomenon for reservoirs on river systems. In the fall, inflow waters have already begun cooling whereas the water storage of a reservoir introduces thermal inertia in the outflow. The same process occurs for natural lakes.

**Climate Change**

**Entire section, page 18:** Climate change was already discussed on page ?? by CRITFC. Climate change models and other studies cited by CRITFC do predict changes in the Snake River basin and other areas of the Pacific Northwest that could increase water temperatures and potentially be detrimental to salmon. With warming already underway, however, as CRITFC had noted in previous sections, it is incongruous that salmon runs in the Frazer River, British Columbia, and the Snake River downstream of HCC are now at record high numbers despite the dire predictions. It is not clear from CRITFC's presentation how a one-week 14.5°C transitional temperature standard between existing standards of 20°C and 13°C will "make the Snake River more susceptible to future climate change impacts on temperatures."

**Temperature Control**

**Entire section, page 18:** The issue of a temperature-control structure (or structures) at HCC for releasing cold water in summer to benefit the lower river biota is a separate matter from the IPC Petition, both procedurally and biologically. From the standpoint of biology, the information from detailed research related to survival and growth at incubation temperatures in the Snake River mainstem is most pertinent. It indicates that no such structure would be needed to maintain high incubation survival and growth of juvenile salmon in the water temperatures of the river at the specified dates in fall. The proposed transition temperature standard of 14.5°C for one week between the summer standard of 20°C and the fall-winter standard of 13°C would be biologically no different for survival of embryos (but would have biological advantage in slightly advanced development rates) from the current 13°C standard for that week.